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# Proceedings of a National Peer Review on Ecological Risk Criteria to Support Integrated Oceans Management

**December 9-11, 2014**
**Ottawa, Ontario**

**Chairpersons: Jake Rice and Andrea White**
**Editors: Michelle Lloyd and James Kristmanson**

Fisheries and Oceans Canada
200 Kent Street
Ottawa, ON K1A 0E6

August 2017

Canada

**Foreword**

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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## SUMMARY

Integrated Oceans Management (IOM) is an approach to planning and managing human activities in the marine environment in order to reduce the potential for conflict and to ensure the sustainable use of shared marine resources and ocean space.

A national science advisory process was held on December 9-11, 2014 in Ottawa, Ontario to provide advice on a scientifically-sound approach for determining the impact of an anthropogenic pressure on ecosystem components and the ecological function they provide. A total of 26 participants, including experts from Fisheries and Oceans Canada and external organisations, attended this advisory process.

Science advice produced at this meeting includes an approach for identifying the degree of impact from a pressure on an ecosystem component, and ultimately on the ecosystem function it provides. Within this approach are ecological impact criteria that are based on increasing degrees of impact on ecosystem function, as result of changes to an ecosystem component. The approach developed at this meeting represents only one aspect of a more comprehensive risk management process for IOM.

## SOMMAIRE

La gestion intégrée des océans (GIO) est une méthode de planification et de gestion des activités humaines en milieu marin visant à réduire le risque de conflits et à assurer l'utilisation durable des ressources marines et de l'espace océanique communs.

Un processus de consultation scientifique nationale a eu lieu du 9 au 11 décembre 2014, à Ottawa (Ontario) afin de fournir des conseils au sujet de l'élaboration d'une approche rigoureusement scientifique visant à déterminer l'impact des pressions découlant des activités anthropiques sur les composantes de l'écosystème et leurs fonctions écologiques. Au total, 26 participants provenant notamment de Pêches et Océans Canada (MPO) et d'autres organisations externes ont pris part à ce processus de consultation.

L'avis scientifique offert lors de cette réunion comprend une méthode permettant de déterminer le degré d'impact d'une pression sur une composante de l'écosystème et, finalement, sur la fonction de l'écosystème qu'elle soutient. Cette méthode comprend des critères d'impact écologiques fondés sur des niveaux d'impact croissants sur la fonction de l'écosystème découlant des modifications apportées à une composante de l'écosystème. La méthode élaborée lors de cette réunion ne représente qu'un aspect d'un processus de gestion du risque plus exhaustif pour les praticiens de la GIO.

## INTRODUCTION

### OPENING REMARKS AND INTRODUCTIONS

The meeting Chairs, Jake Rice and Andrea White, welcomed participants to this national science advisory process and provided an overview of the agenda for the meeting (Appendix I). A total of 26 participants from various sectors (primarily Science and Oceans Management) and from all Regions of Fisheries and Oceans Canada (DFO), as well as several external ecological risk experts attended this science advisory process (Appendix II). J. Kristmanson and M. Lloyd participated as rapporteurs for the meeting.

The Co-Chairs provided context, background, and rationale for the meeting, and participants were asked to familiarize themselves with the Terms of Reference (Appendix III) as it would provide the basis for the science advisory report.

The Co-Chairs also provided information about the scientific peer-review process under the Canadian Science Advisory Secretariat (CSAS), including a working definition for 'consensus' and 'Ground Rules' for meeting participants. The Chairs also outlined products to be produced from this meeting (i.e. a Science Advisory Report, Proceedings, and a Research Document).

### CONTEXT FOR MEETING

Integrated Oceans Management (IOM) is an approach to planning and managing human activities in order to reduce the potential for conflict and to ensure the sustainable use of shared marine resources and ocean space. IOM implementation should be supported by a nationally-consistent approach to the identification of marine areas that are experiencing anthropogenic pressures, the evaluation of the threats posed to the ecosystem by those pressures, and, if required, the selection of appropriate management measures to manage the risks by addressing the identified threats.

The ISO 31000:2009 risk assessment framework indicates steps that should be included in a general risk management process and which have informed the development of an IOM risk management process for Canadian marine areas to date.

One aspect of a nationally-consistent risk assessment process is a scientifically-sound approach for assessing the impact of human activities on ecosystems, which includes understanding how ecosystem function responds to changes in the status of an ecosystem component. This approach must be applicable to different pressures, ecosystem components, and ecosystem functions, and also must be independent of time and space.

## PRESENTATIONS

During the morning of the first day, several presentations were given to meeting participants in order to set the context for the meeting and to provide general background information. After each presentation, a short discussion took place which focused primarily on points of clarification; in-depth discussions specifically related to the objectives of the meeting were conducted in a systematic way once all presentations were given.

## 1) OVERVIEW OF THE REQUEST FOR ADVICE

*Presenter: É-P Maldemay*

The presentation provided an overview of the context for the request for Science advice. The Oceans Program is currently developing a risk management process to inform decision-making for IOM and this process may be used in a variety of ways such as:

- To identify and manage pressures that pose a risk to ecosystems and to prioritize issues/areas/ecological components or functions for management;
- To assist in the development of operational (SMART) objectives and/or targets and the selection of threat/ecological monitoring indicators;
- To analyze management gaps and to select/design appropriate management measures including determining which activities are compatible/incompatible with the conservation objectives of the *Oceans Act* Marine Protected Areas (MPAs) in order to inform decision making; and
- For adaptive management based on evaluation of ecological monitoring trends and pressure monitoring trends in relation to ecological objectives.

In order for the Oceans Program to implement a comprehensive risk management process, a national set of impact criteria are required to ensure consistency in how risk is calculated/analyzed/rated. A standardized approach would ensure that all human activities are considered in a fair, science-based, and consistent manner regardless of activity, time, and space. It was noted that although the impact criteria would need to be general enough to be applicable across multiple geographic scales (e.g. bioregion, marine protected area, etc.), it was also important they were applicable and practical.

**Discussion**

It became immediately obvious that a glossary must be included in the Science Advisory Report given the variability in use and understanding among participants regarding terminology. Specifically related to this issue were the differences in opinion regarding the word "criteria" and what it meant in the context of this advisory process. It was confirmed that the focus should be on ecological impact criteria.

The co-chairs reiterated that this meeting was not tasked with tackling the overall risk management process as this was under development by the Oceans Program. However, the co-chairs noted that participants should concentrate on drafting an approach for determining the potential ecological impacts of anthropogenic activities, and that this approach would be one aspect of the more comprehensive risk management process. The process should be applicable to all parts of the ecosystem and be generic enough to include any species of interest.

It was also emphasized by the co-chairs that although non-ecological impacts (e.g. economic, social, and cultural) may occur as a result of anthropogenic activities, these types of impacts were outside the scope of this advisory process (although they would likely be considered in addition to ecological impacts in a comprehensive risk management process).

## 2) RISK CRITERIA – HOW ARE THEY USED IN PRACTICE?

*Presenter: R.Cormier*

The presentation provided a general overview of how risk criteria are used in assessment and management. Risk criteria have different roles in the assessment of risk versus management decision making process. In management, the definition of risk is considered as the effect of uncertainty on legislative and policy objectives, for example. Although risk is typically characterized in combination with the consequences of an event and associated likelihood, uncertainty, reflects the state of deficiency of information and knowledge including the ability or capacity to manage the risks to a level "as low as reasonably practicable". Risk criteria are technically the terms of reference against which the significance of risk can be understood and evaluated by all involved in a decision-making process. These are usually based on policy objectives as well as standards, laws, and other requirements. They are used to classify the severity of the risks to inform a management decision. In management, risk criteria typically classify the severity of potential environmental, cultural, social and economic consequences or legal repercussions.

Within the context of a scientific ecological assessment, criteria are mostly used to classify the magnitude or level of impact as a result of an analysis of a cause and effect pathway. These assessments can also provide a probability estimate. They do not, however, classify severity and are not, therefore, risk criteria per se. The criteria provide scientific objectivity and neutrality. Such criteria can be defined by legislation or policy such as the criteria used for recovery potential of species at risk or in terms of habitat change effects on fisheries productivity. Such criteria set the management context for consistency of approach in scientific advisory processes avoiding bias from perceptions and values. They can provide a framework for the development and use of indicators and monitoring by defining the boundaries of regime shifts or state. Within a management context, they provide a benchmark to compare outcomes for management scenarios, alignment of risks with legislative and policy objectives and expected outcomes, harmonized evaluation of management measures based on their outcome equivalency instead of the measures themselves or the uniqueness of the ecosystem component. Attributes for consideration in the development of criteria may include sensitivity or susceptibility of ecologically and biologically significant areas (EBSAs) and species to pressures; boundaries of the ecosystem or ecoregion; physical changes, chemical interferences or biological disturbances or potential for recovery after impact.

### Discussion

Participants discussed various aspects of the risk management approach and risk assessment process. It was discussed that management will set their own risk tolerance/ aversion levels. However, what science can do is provide management with sound advice regarding ecological thresholds to guide to their actions. This led participants to agree that it was important to establish the ecological and management context and scope (i.e. rationale, objectives, ecosystem components, pressures, governance structure, geographical area, historical information, etc.) early in the risk management process.

There was a question on the necessity to draft criteria for key functions in EBSAs or key stressors and this led to discussion on how objectives, pressures, components and criteria were linked. It was pointed out that there are conservation objectives for EBSAs and what is needed is practical advice on criteria for ecological components and functions. The fishery Precautionary Approach (PA) framework Limit Reference Point (LRP) was put forth as an example of a criterion that was applicable to any species.

Participants agreed that this meeting was really about how to determine how potential pressures may impact aspects of the ecosystem and that ecological risk criteria terminology did not accurately convey this.

## 3) OVERVIEW OF PRIMARY WORKING PAPER: DESIGN OF ECOLOGICAL RISK CRITERIA FOR THE INTEGRATED MANAGEMENT OF CANADIAN OCEANS

*Presenter: D. de Kerckhove*

The purpose of the presentation was to investigate and compare the categories and thresholds associated with Ecological Risk Criteria (ERC) used in Canada and elsewhere for risk assessment and management within the context of integrated oceans management. Two main questions were addressed, 1) How well aligned are other categories or thresholds with DFO's 2006 ERC and is there a more appropriate/practical structure (e.g. a three-level ERC), and 2) How are particular cases assigned to categories, and what is the biological significance of each criteria? The review of existing ERCs was based on our understanding of the risk management process as it relates to ocean ecosystem management as outlined by ICES Marine and Coastal Ecosystem Based Risk Management Handbook (an ISO 31000:2009 process) and the Pacific ERAF developed by O et al., and the Australian ERAEF developed by Hobday et al.

A variety of ERC definitions and thresholds can be found in related frameworks and studies in and out of Canada. There are many appropriate models for both 3 and 5 category ERCs. It is recognized that the lowest category (negligible effects) is often not noted, and that the medium risk level can be partitioned or broadened based on management objectives. Fundamental thresholds are one of concern and one that is intolerable leading to a 3 Category ERC, but there is generally some difficulty in determining at what point thresholds become too uncertain to be helpful given natural variation.

**Discussion**

Discussion focused on the differences between Ecological Risk Criteria vs Ecological Impact Criteria, likelihood and uncertainty. The focus should be on describing characteristics associated with ecological thresholds or boundaries between categories. Where the ecological function is in relation to a threshold would be determined via a detailed assessment of the particular component/function.

It was agreed upon that participants need to define terminology and use terms consistently, and be clear about the content of the working paper and science advisory report. It was agreed a glossary would be included in the SAR.

## 4) OVERVIEW OF 3-CATEGORY FRAMEWORKS – WHAT IS OUR FOUNDATION?

*Presenter: J. Rice*

This presentation highlighted the functional differences between the 3-category risk management process used in the fisheries precautionary approach framework (FPA), and in the fisheries protection policy process (FPP).

In the FPA process, the axes represent an index of abundance/status (X axis) and of productivity (y axis). In the FPP framework, the x axis represents habitat, with relatively undisturbed habitats at the origin. The y axis is some index of productivity of the ecosystem component.

These two processes thus appear very similar, graphically; merely with their x-axes reversed. However they manage risk and take account of uncertainty in very different ways, and the

differences are fundamental to making decisions about the preferred approach to risk management in oceans conservation and sustainable use.

**Discussion**

There was a lengthy discussion among participants regarding the two approaches. Most of the discussion focused on the shape of the curve and how to determine where the point of change occurred between two categories, especially if the shape of the curve was unknown (i.e. no/ limited data situations). The number of appropriate categories (i.e. 2, 3 or 5) was also discussed.

Throughout the discussion the term 'risk' was used in different ways, which often led to confusion, and provided additional justification for the inclusion of a glossary in the SAR.

## DISCUSSION RELATED TO THE MEETING OBJECTIVES

### CONTEXT AND BACKGROUND

To establish the context for this science advice, it was agreed that this meeting was about ecological impact criteria (how ecosystem function responds to changes in the state of ecosystem components as a result of a stressor/pressure) and not ecological risk criteria as described in the Terms of Reference (Appendix III).

Participants also discussed the role of science in providing advice to management, and what science advice they could (or could not) provide. For example, science can provide advice on the state of the ecosystem (i.e. ecosystem function, ecosystem components, etc) and the pressures impacting the ecosystem, and establish ecological thresholds to guide management decision. However, it is not appropriate for science to provide advice on management aspects, such risk tolerance/aversion levels.

### GLOSSARY

A difference in the use of various terms was a continuous source of confusion during the meeting (e.g. risk, impact, function, component, criteria, category, boundary, threshold, etc.). To ensure consistency of terminology, participants developed a glossary. Even in the development of the glossary there was a lot of discussion about the definition of each term, and which term best represented the meaning the participants wanted to capture (e.g. pressure vs stressor, risk vs impact, criteria vs category, etc.). In the end consensus was reached and a glossary was included in the SAR.

### ECOLOGICAL IMPACT CRITERIA FOR RISK ASSESSMENT PROCESS

There was a lot of discussion about how the ecological criteria would be used and how they fit into the risk assessment process. Lengthy discussion arose because of confusion in terminology, approach (i.e. national risk management approach in development), process (i.e. various Regional risk assessment tools), and preconceived ideas about what the criteria should look like and what it would do. Participants were often reminded that we were developing 'national' ecological impact criteria that would be general enough to be applied across a wide range of situations, geographic locations and scales, timings and human activities, yet specific enough to address complex ecological responses to environmental pressures. Some participants wanted very situation/scale/activity specific criteria. In the end it was agreed upon, that specific examples to provide guidance on how to apply the criteria in the risk assessment process would be useful to provide in an appendix of the science advisory report.

## COMPARISON OF FISHERIES PROTECTION POLICY (FPP) AND FISHERIES PRECAUTIONARY APPROACH (FPA) FRAMEWORKS

There was a lengthy discussion about two relevant existing approaches: FPP and FPA. The concept of a three-zone framework is that the extremes (the healthy and critical zones) represent areas of stable management choice and the middle or cautious zone is an area of active management. It was observed that the two curves looked similar and the axes were just flipped, however they represent very different approaches. There was discussion on the differences between three and five category frameworks and it was agreed that in most cases there was not enough information to discriminate more than three categories, although a 5 category framework would be an ideal scenario as it allows for a proactive approach to decision-making as one nears a threshold. It was noted that using one of these frameworks would align Oceans decision-making with other Departmental approaches and avoid conflicts and cross-purposes in the process. There was consensus that a three zone framework was the best way forward and that the FPP approach made the most sense from the Oceans perspective.

Other points raised included how to deal with cumulative effects and the characteristics of boundary/thresholds for components and functions of the ecosystem.

## CATEGORIES & BOUNDARIES OF ECOLOGICAL IMPACT CRITERIA

The definition of ecological impact criteria (i.e. categories and boundaries) and the scope of the criteria were also thoroughly discussed. Participants had many ideas around what the ecological impact criteria for integrated oceans management would look like (i.e. how do we actually define/assign these categories and boundaries, and how these would be used). There was a lot of discussion about was meant by each category (i.e. critical zone/ loss of function, cautious zone/ changing function, or healthy zone/ maintaining function) and boundary (i.e. point of change) of ecological impact criteria. Discussions focused on how to define the ecosystem state (i.e. ecological component and ecological function) in each category, and how to define the boundary between the categories.

There was agreement on the definitions for the three categories and that criteria were to be used to place a function within a category. The level of pressure on an ecosystem component would determine the level of the criteria and therefore indicate the category (based on status of the related function). There was discussion around the twelve classes of pressures provided as examples in the FPP framework and it was noted that eventually adopting something similar for the marine environment would be useful.

## CONCLUDING REMARKS

The Co-Chairs thanked participants for their input and their patience during difficult discussions, and for reaching consensus on the science advisory report. Details of a science-based approach to assessing how impacts to an ecosystem component are related to the response of ecosystem function are provided in the related science advisory report to this meeting.

## APPENDIX I: AGENDA

**National Science Advisory Process on**
**Ecological Risk Criteria for Integrated Oceans Management**

December 9-11, 2014
Lord Elgin Hotel (Québec Room)
Ottawa, Ontario

Meeting Chairpersons: Jake Rice & Andrea White

**Tuesday, December 9th**

09:00 – Welcome & Introductory Remarks (*Co-Chairs*)

09:30 – Overview of Request for Advice
(*Émilie-Pier Maldemay; Oceans & Fisheries Policies Branch, DFO*)

09:50 – Risk Criteria – How Are They Used In Practice?
(*Roland Cormier; Eco Risk Management*)

10:15 – Overview of 2013 Ecological Risk Criteria Document – What is Our Foundation?
(*Jake Rice; Ecosystem Science Directorate, DFO*)

10:30 – HEALTH BREAK

10:45 – Overview of Primary Working Paper: Design of Ecological Risk Criteria for the Integrated Management of Canadian Oceans (*Dak de Kerckhove; Consultant*)

12:00 – LUNCH (not provided)

13:30 – Further Discussion of de Kerckhove paper (*Group Discussion; Led by Co-Chairs*)

15:00 – HEALTH BREAK

15:15 – Presentation of draft outline of Science Advisory Report
(*Andrea White; Ecosystem Science Directorate, DFO*)

15:30 – Drafting of SAR – Risk Categories (*Breakout Groups*)

16:45 – Submission of draft text and wrap up of Day 1

17:00 – Adjournment of Day 1

**Wednesday, December 10th**

09:00 – Recap of Day 1 and Path Forward for Day 2

09:15 – Discussion of text re: Risk Categories (*Group Discussion; Led by Co-Chairs*)

10:30 – HEALTH BREAK

10:45 – Drafting of SAR – Boundaries and Uncertainties (*Breakout Groups*)

12:30 – LUNCH (not provided)

13:30 – Drafting of SAR continued (*Breakout Groups*)

15:00 – HEALTH BREAK

15:15 – Discussion of text re: Boundaries and Uncertainties
(*Group Discussion; Led by Co-Chairs*)

17:00 – Adjournment of Day 1

**Thursday, December 11th**

09:00 – Recap of Day 2 and Path Forward for Day 3

09:15 – Finalisation of SAR (*Group Discussion; Led by Co-Chairs*)

10:30 – HEALTH BREAK

10:45 – Finalisation of SAR continued (*Group Discussion; Led by Co-Chairs*)

12:30 – LUNCH

13:30 – Wrap up and Discussion re: Next Steps (*Group Discussion; Led by Co-Chairs*)

14:30 – Adjournment of Science Advisory Process

## APPENDIX II: ATTENDEES

| Name | Affiliation |
|---|---|
| Jake Rice | Chair; DFO Science, NCR |
| Andrea White | Chair; DFO Science, NCR |
| James Kristmanson | DFO Science, NCR |
| Michelle Lloyd | DFO Science, NCR |
| Miriam O | DFO Science, PAC |
| Rob Young | DFO Science, C&A |
| Michael Scarratt | DFO Science, QC |
| Cathrine Couillard | DFO Science, QC |
| Eddy Kennedy | DFO Science, MAR |
| Nadine Templeman | DFO Science, NCR |
| Sara Lewis | DFO Science, NL |
| Atef Mansour | DFO Science, NL |
| Emilie-Pier Maldemay | DFO Oceans, NCR |
| Martine Giangioppi | DFO Oceans, NCR |
| Joy Hillier | DFO Oceans, PAC |
| Joclyn Paulic | DFO Oceans, C&A |
| Nicolas Lemaire | DFO Oceans, QC |
| Ray MacIssac | DFO Oceans, GULF |
| Heather Breeze | DFO Oceans, MAR |
| Laura Pilgrim | DFO Oceans, NL |
| Calvyn Wenghofer | DFO Oceans, NCR |
| Jenifer MacDonald | DFO Species at Risk Program |
| Derek Osborne | DFO National Fisheries Policy |
| Dak de Kerchove | Consultant; Post Doc , University of Toronto |
| Roland Cormier | Consultant; Eco Risk Management |
| Rebecca Martone | Research Associate, Center for Ocean Solutions, Stanford Woods Institute for the Environment |

**DFO = Fisheries and Oceans,*
*NCR = National Capital Region,*
*PAC = Pacific Region,*
*C&A = Central and Artic Region,*
*QC = Quebec Region,*
*GULF = Gulf Region,*
*MAR = Maritimes Region,*
*NL = Newfoundland and Labrador Region,*

## APPENDIX III: TERMS OF REFERENCE

**Ecological Risk Criteria to Support Integrated Oceans Management**

**National Peer Review – National Capital Region**

**December 9-11, 2014**
**Ottawa, Ontario**

Chairpersons: Jake Rice and Andrea White

**Context**

Integrated Oceans Management (IOM) is an approach to planning and managing human activities in order to reduce the potential for conflict and to ensure the sustainable use of marine resources and the shared use of ocean space. IOM is central to oceans management at Fisheries and Oceans Canada (DFO) as per the *Oceans Act*, *Canada's Ocean Strategy*, the *Policy and Operational Framework for Integrated Management of Estuarine, Coastal, and Marine Environments in Canada*, and the *National Framework for Canada's Network of Marine Protected Areas* and the *National Framework for Establishing and Managing Marine Protected Areas*. A number of Canadian Science Advisory Secretariat (CSAS) advisory processes related to addressing aspects of IOM have already taken place (e.g. biogeographic classification, identification of Ecologically and Biologically Significant Areas (EBSA), conservation objectives for Marine Protected Areas (MPA), development of Pathways of Effects models, selection of ecological indicators, etc.).

A key component of IOM is a consistent approach to the identification of marine areas that are experiencing human-induced pressures, the evaluation of the risks to the ecosystem associated with those pressures, and the selection of appropriate measures that will maintain or mitigate the impacts of such pressures within pre-defined tolerance levels. The 'ISO 31000:2009 Risk Management - Principles and Guidelines' is a tool that can facilitate risk management in the marine environment; however, ecological risk criteria that can be consistently applied independent of time, scale, location, and activity are required for the integrated management of Canadian oceans. For the purposes of this advisory process, 'criteria' is defined as categories indicating varying degrees of risk (e.g. high, medium, low).

This advisory process aims to produce a set of ecological risk criteria that are scientifically sound and that are operational for the management of human activities in Canadian oceans (e.g. EBSAs, MPAs, and other areas). These ecological risk criteria will assist in determining the level of risk to ecosystem features from human activities and may inform the selection of management measures to minimise these risks.

**Objectives**

This advisory process will:

1. Review the ecological risk criteria included in the draft document 'Ecological Risk Criteria to Support Decision Making and Management in the Oceans Management Program (November 2013)';
2. Consider existing Departmental ecological risk criteria (e.g. the Fisheries Protection Program, Species At Risk Program, previous work within the Oceans program, etc.) and non-DFO ecological risk criteria, where appropriate; and
3. Draft ecological risk criteria based on 1) and 2) that may be applied independent of time, scale, location, and activity, and which include clear indications of the boundaries between each risk criterion.

Note that the level of risk tolerance considered appropriate in oceans management and decision-making will not be discussed at this advisory process.

**Expected Publications**

- Science Advisory Report
- Proceedings
- Research Document(s)

**Participation**

- Fisheries and Oceans Canada (DFO) (e.g. Ecosystems and Oceans Science and Ecosystems and Fisheries Management sectors)
- Other invited experts